SYNOPSIS OF RESEARCH PROJECT

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8.	**Title of research problem**	:	**IMPACT ASSESSMENT OF PRADHAN MANTRI KISAN SAMMAN NIDHI (PM-KISAN) YOJANA ON THE FARMERS OF SAURASHTRA REGION IN GUJARAT**

9. Introduction

India, with one of the largest populations in the world, has a significant share of its people dependent on agriculture for their livelihoods. Farmers play a vital role in sustaining the country's economy. Despite their importance, the agricultural sector remains relatively underdeveloped and faces numerous challenges, leading to low productivity and unstable financial conditions for farmers. Programs like Pradhan Mantri Fasal Bima Yojana, Pradhan Mantri Krishi Sanchay Yojna, Soil Health Card, and National Agricultural Market, among others, have been implemented in the past to improve the economic and social circumstances of farmers with the aim of empowering them and revolutionizing the agricultural sector. By implementing Direct Benefit Transfer (DBT) programs, the central government has recently been committed to supporting several agricultural community sectors. These initiatives aim to provide funding to meet agricultural demands and enhance farmers' socioeconomic circumstances. Compared to traditional subsidy programs, DBT programs have many

advantages, such as greater efficiency and transparency. They provide the beneficiary with steady and dependable income.

Direct Benefit Transfer schemes offer recipients a stable and reliable source of income. These programs, now implemented in many parts of the world, have significant implications for improving people's socio-economic conditions. Studies have shown that DBT initiatives positively influence household expenditure, strengthen coping strategies, improve school attendance, encourage healthier food choices, increase spending on health and education, and enhance overall living standards. Despite these benefits, agriculture in rural India continues to face several challenges. In response to this, the Government of India introduced the Pradhan Mantri Kisan Samman Nidhi scheme as a DBT initiative specifically aimed at providing financial support to farmers.

The PM-KISAN scheme is a central sector initiative of the Government of India that provides financial assistance of ₹6,000 per year to eligible farmer families. Launched on February 24, 2019, in Gorakhpur, Uttar Pradesh, the scheme primarily targets small and marginal farmers. The financial support is distributed in three equal instalments of ₹2,000 each and is directly transferred to beneficiaries' bank accounts. The main objective of the scheme is to ensure income security and support farmers in meeting their basic agricultural and household needs. It represents a significant effort to improve the standard of living of farmers across the country.

Since its implementation, the scheme has benefited millions of farmers and aims to reduce rural poverty and distress. However, its effectiveness in increasing farmers' income varies depending on factors such as landholding size, regional differences, and the efficiency of implementation at the grassroots level. The scheme also includes provisions for identifying and registering eligible beneficiaries and is administered by the Department of Agriculture, Cooperation and Farmers Welfare under the Ministry of Agriculture and Farmers Welfare.

To avail benefits, farmers must register through their respective state governments or Union Territory administrations. The Direct Benefit Transfer mechanism transfers the money straight to bank accounts, guaranteeing transparency and minimizing leaks. The scheme targets approximately 14 crore farmer families across India. By providing timely financial assistance, it helps farmers manage

agricultural expenses and improve their income stability. It also promotes financial inclusion by encouraging farmers to access formal banking services.

Furthermore, the scheme forms part of a broader strategy to address agrarian distress and enhance the socio-economic conditions of farmers. It complements other agricultural initiatives aimed at increasing productivity, encouraging sustainable practices, and providing support during adverse situations such as crop failures or natural disasters. Increased financial support to farmers can also stimulate rural economic activity by boosting their purchasing power, which in turn benefits sectors like retail, manufacturing, and services. While PM-KISAN offers crucial income support, long-term improvements in agriculture require addressing deeper structural issues such as market access, irrigation, and technological adoption. Beyond immediate financial relief, the scheme contributes to poverty reduction, food security, and overall rural development. By enabling farmers to make better decisions regarding their farming activities and investments, and by encouraging modern agricultural practices, it supports the foundation for sustainable agricultural growth and rural prosperity.

In Gujarat, the PM Kisan Yojana is fully operational, and qualified farmers get ₹6,000 a year through direct transfers in three instalments. The state administration was actively overseeing beneficiary identification and offering extra agricultural assistance while the 21st instalment was being delivered in late 2025.

Only the families of farmers whose names are included in the land records will receive the benefit. The deadline for determining a beneficiary's eligibility under the program is February 1, 2019, and any adjustments made after that date will not be taken into account for the following five years.

9.1 PM-KISAN Portal

The responsibility of identifying eligible beneficiaries under the scheme lies with the respective States and Union Territories. They maintain records of farmers either in manual registers or through digital systems. To streamline the process, a centralized online platform known as the PM-Kisan Portal (http://pmkisan.gov.in) has been developed, allowing States and UTs to upload beneficiary data in a uniform format. This system facilitates smooth and coordinated transfer of benefits across the country. In addition, the Ministry of Agriculture and Farmers' Welfare has introduced a round-

the-clock automated IVRS helpline, enabling farmers to easily check the status of their application and payments.

9.2 PM-KISAN Mobile App

The Hon'ble Minister of Agriculture released the PM-KISAN mobile app on February 24, 2020. This was created with the goal of reaching more farmers and increasing openness. A straightforward and effective addition to the PM-KISAN web portal is the PM-KISAN mobile app.

9.2.1 Kisan e-mitra

On September 21, 2023, the Union Ministry of Agriculture and Farmers' Welfare, Government of India, launched an AI-powered chatbot for the Pradhan Mantri Kisan Samman Nidhi scheme. This chatbot was integrated into the scheme's grievance redressal system to provide farmers with a simpler and more user-friendly way to access information.

In its initial phase, the chatbot helps farmers track their application status, check payment details, understand reasons for ineligibility, and receive other important updates related to the scheme. It is also linked with Bhashini, enabling multilingual communication to cater to the diverse linguistic background of beneficiaries across the country. Farmers can access this feature through the PM-KISAN mobile application. Overall, the introduction of this advanced technology is expected to improve transparency, enhance accessibility, and support farmers in making better-informed decisions.

10. Rational of the study

Indian farmers are heavily indebted, and their revenue is flat and unpredictable (Reddy *et al*, 2020). Due to their lack of access to traditional loans, almost half of India's agricultural households continue to rely on unofficial sources for their financial needs. 48 per-centage of farmers in Uttar Pradesh are utilizing PM-KISAN payments for domestic purposes, according to research. This study could help us understand how farmers' living standards are impacted by using the funds from this arrangement (Saloni and Kumar, 2023). Research will examine shifts in household costs as well as access to

high-quality healthcare and education. Knowing these factors makes it easier to assess how well the program is raising farmers' standards of living and to understand the utilization pattern of the funds. Most of the existing literature has primarily focused on evaluating the economic impact of the PM-KISAN in various states across India. However, relatively limited research has been undertaken to systematically assess its impact within Gujarat. In this context, the present study represents a distinct and timely effort to examine the effectiveness of PM-KISAN in influencing farmers' income and improving their living standards. By focusing specifically on Gujarat, the study seeks to fill an important research gap and provide region-specific empirical evidence that can contribute to more informed policy formulation and implementation. The Hon'ble Prime Minister has disbursed over Rs.18,640 crore directly into the bank accounts of more than 9.32 crore farmers as part of the 22nd instalment of the PM-KISAN scheme.

Keeping in view of the above discussion, the research topic entitled "Impact Assessment of Pradhan Mantri Kisan Samman Nidhi Scheme in Saurashtra Region of Gujarat" will be undertaken with the following specific objectives.

11. Objectives of the study

1. To study the socio-economic profile of the beneficiary farmers.
2. To assess the impact of PM-KISAN scheme on farmer's income and living standard.
3. To analyze the change in agricultural investment pattern.
4. To examine the utilization pattern of PM-KISAN funds by the beneficiaries.
5. To identify the constraints faced by the beneficiaries.

11.1 Hypothesis

1. There is no significant variation in the socio-economic characteristics among beneficiary.
2. The PM-KISAN scheme has no significant impact on farmer's income and living standards.
3. There is no significant change in the agricultural investment pattern of farmers after receiving PM-KISAN benefit.
4. PM-KISAN funds are not significantly allocated toward productive agricultural uses.

5. Beneficiaries do not face significant constraints in accessing ir utilizing PM-KISAN benefit.

11.2 Limitations of the study

The research is confined to the Saurashtra region of Gujarat; therefore, the findings may not be generalizable to other regions with different agro-climatic, socio-economic, and institutional conditions and the analysis is based on a selected sample of beneficiary farmers, which may not fully capture the heterogeneity of all beneficiaries under the PM-KISAN scheme.

12. Review of literature

The review of literature is an essential part of any research study, as it offers a thorough understanding of the existing body of knowledge on a given topic. It helps in identifying relevant theories, methodologies, and empirical evidence that have contributed to the development of the field over time. By analyzing earlier studies, researchers can recognize the work already completed, highlight areas of disagreement, and identify existing research gaps. A systematic evaluation of prior research ensures that the current study makes a meaningful contribution to both academic understanding and policy discussions. The literature related to the selected objectives is discussed in the following section.

Aftab *et al*. (2026) carried out research on evaluating the impact of Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) scheme on farmer's livelihoods, agricultural productivity, and rural development in India: A review. This review evaluates its effects on rural development, agriculture productivity, and livelihoods. According to existing research, the program's advantages are somewhat countered by inflation and the exclusion of landless workers, even while it increases cash flow and lessens dependency on unofficial loan sources. There are clear regional differences, with some jurisdictions reporting greater adoption rates and quantifiable income increases. Its efficacy is constrained by implementation issues like late payments, out-of-date land records, and administrative inefficiencies. In order to improve long-term sustainability, the report ends with legislative recommendations that include raising payout amounts, broadening beneficiary coverage, enhancing administrative procedures, and tying payments to agricultural advising services.

Nishali, (2023) conducted a study on Pradhan Mantri Kisan Samman Nidhi (PM-KISAN). This study's main objective was to investigate the financial support the state provides to farmers. The initiative mostly relies on secondary data from publications such as reports, magazines, and newspapers. Data collected from secondary sources is evaluated using regression analysis, t-tests, graphs, charts, and other statistical techniques. The Northeast district of Delhi has the highest concentration of PM Kisan program beneficiaries in the NCT. His PM-Kisan program has the greatest number of recipients in the Karnataka district of Shivamogga. The Dharmapuri district is home to the majority of Tamil Nadu's PM-Kisan program enrollees. The UNA District has the most recipients of the PM-Kisan program in Himachal Pradesh.

Rishab *et al*. (2023) conducted research on socio-economic and personal characteristics of the beneficiaries under PM-KISAN samman nidhi scheme. The study found that the, the majority of respondents (61.66%) were older, belonged to another backward caste (45%), had small families (87.50%), had low land holdings (45.00%), and were functionally illiterate (30.83%). They also belonged to only one organization (38.33%) and had medium levels of annual income (65.83%) and farming experience (57.5%). The findings showed that most respondents had a moderate level of risk aversion, economic motivation, scientific orientation, and originality. The technique is usually effective in the research area, notwithstanding the respondents' recommendation for an annual revision of instalments.

Rishab *et al*. (2023) carried research on assessment of awareness level of the beneficiary farmers of Pradhan Mantri Kisan Samman Nidhi scheme. According to the survey, 58.33 percent of participants had a thorough understanding of the PM-Kisan system. At the 1% level of significance, a positive correlation was found between age, family size, agricultural experience, and four other independent characteristics. Nonetheless, there is a positive link between awareness level and variable annual income at a 5% significance level.

Padmaja *et al*. (2024) conducted a study on from policy to practice: exploring beneficiary farmers utilization of PM-KISAN funds. The findings showed that the two fiscal years' fund consumption patterns had changed. In 2021–2022, non-agricultural spending increased from 41.67% to 78.33%, while agricultural spending gradually decreased from 58.33% in the first instalment to just 15.00% in the third. In contrast,

agricultural spending increased significantly in the first two instalments of 2022–2023, reaching a peak of 80.33%, before falling to 28.67% in the third instalment. Similar trends were seen in non-agricultural spending, which significantly increased near the conclusion of the fiscal year. The results indicate that although the PM-KISAN program encourages investments in agriculture at the beginning of the fiscal year, as the year goes on, the money is more transferred to family expenses.

Varshney *et al*. (2020) study explored that Pradhan Mantri Kisan Samman Nidhi and the adoption of modern agricultural technologies. The study shows that the PM-KISAN project has significantly increased Krishi Vigyan Kendras' (KVKs') ability to encourage the usage of contemporary paddy varieties. This study found that the adoption rate of contemporary cultivars among KVK program participants was 36 percentage points greater than that of non-beneficiaries. This study showed how, when combined with PM-KISAN, agricultural extension systems like KVKs may motivate farmers to make more strategic investments in agriculture.

Akhtar, (2022) conducted the study on the impact of PM-KISAN on farm income of beneficiaries in Uttar Pradesh. The impact of the program was evaluated by comparing the agricultural earnings of beneficiary and non-beneficiary farms. In comparison to non-beneficiary farms, which had an estimated per household income of Rs. 43,573, beneficiary farms had an estimated per household net income of Rs. 48, 334 in the reference year, which was 9.85% greater.

Gopi and Rangappa, (2021) studied the utilization pattern of PM-KISAN benefits. The study found that, in comparison to other districts, the Davanagere district's beneficiaries are comparatively impoverished. The PM-KISAN benefits are expensed for a variety of reasons. The majority of recipients spend money on productive activities and comparatively less on unproductive ones.

Saloni *et al*. (2023) carried research on expenditure pattern of PM-KISAN samman nidhi instalments: An empirical study in western Uttar Pradesh. The investigation showed that about 40% of the beneficiaries used this money for agricultural and farm-related activities, and about 50% of the farmers used it for general domestic expenses. This spending pattern was shown to be caused by the fund's insufficiency. A few

recommendations of this study include regular grant disbursement and revising the criteria to identify targeted individuals.

Reddy *et al*. (2021) studied an economic analysis of PM-KISAN scheme in Ri-Bhio district of Meghalaya State for the year 2020-21. By conducting in-person interviews with farmers using a specially designed and pre-tested schedule, primary data on the costs and returns of the paddy crop (main crop) were gathered. The cost of cultivation, gross returns, and net returns increased by 2.14 percent, 4.74 percent, and 8.71 percent, respectively, for beneficiaries compared to non-beneficiaries in Kharif 2020–21, according to the cost and returns calculations. This demonstrates that recipient farmers are willing to spend more for higher returns and that farmer suffering has somewhat decreased. The analysis concludes that the PM-Kisan system benefits the recipient farmers to extent.

Naik *et al*. (2022) conducted research on the performance of PM-Kisan samman nidhi yojana in Karnataka to understand the utilization pattern of the funds. The study was confined to the Kalyan Karnataka region. The results of the study reveals, the PM KISAN scheme's funds are mostly utilized to purchase pesticides (11.67%), fertilizers (15%), and seeds (38.33%). Newspapers (20%) and banks (16.67%) were the next most common sources of information about the initiative, after other farmers (36.67%). Raichur had the most beneficiaries in the Kalyan Karnataka area, followed by the districts of Koppal and Kalaburagi. The largest percentage of beneficiaries was found in Uttar Pradesh (22.77%), followed by Madhya Pradesh (7.54%), Bihar (7.23%), and Maharashtra (10.11%). With 5.16% of India's PM Kisan scheme recipients, Karnataka is placed seventh.

Singh *et al*. (2025) studied the role of PM Kisan samman nidhi in enhancing farmers knowledge and adaption of modern onion production technologies: A review. In onion farming, PM-KISAN has improved input access, technology uptake, and income stability. Additionally, benefiting farmers have benefited from improved post-harvest management and price realization. However, regulatory changes are required to guarantee inclusion, prompt finance transfers, and better interaction with extension and horticultural support systems in order to optimize its impact. PM-KISAN can be a major force behind profitable, climate-resilient, and sustainable onion production systems with ongoing monitoring and region-specific tactics.

Madhu and Uma, (2024) evaluated the impact of regional disparities of the Pm-kisan scheme in India and the results shows that beneficiaries and monies disbursed increased significantly until 2021–2022, after which they declined in 2022–2023. Bihar and Maharashtra also had considerable engagement, but Uttar Pradesh always had the greatest number of beneficiaries. Significant geographical variations in the beneficiary distribution for 2022–2023 were found by the Kruskal-Wallis test. While highlighting the scheme's general success, the research also identifies problems such regional disparities and problems with data verification. Strategies for enhancing implementation and guaranteeing a more equitable distribution of benefits are among the policy recommendations.

Ghosh *et al*. (2024) examined the performance of cash transfer programs on farmers livelihood: evidence from PM-KISAN scheme in India. The study concludes that the PM-KISAN scheme has a positive and statistically significant impact on farmers' livelihood status, as evidenced by the higher Livelihood Index (0.396) among beneficiaries compared to non-beneficiaries (0.366). The Propensity Score Matching results show that income support significantly improves rural livelihoods, with improvements ranging from 3.34 to 4.13 percentage points. The impact is still moderate, though, indicating that PM-KISAN is insufficient on its own to bring about significant change. In order to promote sustainable and long-term agricultural growth, its efficacy can be greatly increased when combined with complementary interventions including access to contemporary technologies, high-quality inputs, and extension services.

Kaleeswaran *et al*. (2024) conducted a rank-based quotient analysis of constraints faced by PM-KISAN beneficiaries across southern states of India: Key issues and policy implications. The findings reveals, 98.2% of farmers expressed concern about the inadequacy of the ₹6,000 annual subsidy, which many believe is insufficient to support significant agricultural investment. Other significant problems include exclusion due to out-of-date land records (88.8%), tenant farmers' ineligibility (85.5%), money payout delays or inconsistencies (75.4%), and low knowledge of the scheme's provisions (70.5%). Overall, the findings point to the need for policy changes, including raising funding, updating eligibility requirements, and raising awareness and openness.

Jagadeeswari *et al*. (2021) identified the PM-KISAN: Easing liquidity constraints of the farmers as by investing in cutting-edge technology and giving impoverished farmers subsidized inputs, PM-KISAN and agricultural advising services have the ability to end the cycle of intergenerational poverty and low farmer earnings.

Verma *et al*. (2022) conducted a research on an economic analysis of fund utilization by different categories of beneficiary farmers under PM-KISAN scheme in Jammu region of J &K (U.T.). This study highlights positive effects on income, risk-taking, and rural economic activity, evidence on sustained agricultural investment and technology adoption remains limited. Moreover, a significant share of funds may still be used for consumption in developing economies. Therefore, PM-KISAN offers a valuable context to examine whether direct income support leads to meaningful and long-term changes in farmers' investment behaviour.

Bhadwal and Kumar, (2022) studied the fund utilization pattern of PM-KISAN beneficiaries in Kangra district of Himachal Pradesh using 80 farmers' sample. The study revealed that the farmers who received PM-KISAN subsidies during the off-season reported using them for consumption, but those who received them during the agricultural peak season reported using them for agriculture. The way marginal farmers used their funds was very different from that of small farms. According to the findings, the government should ideally increase, reorganize, and disburse the payment amounts while taking the farmers' seasonal demands into consideration. The potential area that needs to be addressed is the provision of skill-building training to farmers. For upcoming research and policy decisions pertaining to such programs, this report would be a reliable resource.

Yadav, (2025) carried research on an economic impact of Pradhan Mantri Kisan Samman Nidhi Scheme in Kanpur Dehat district of Uttar Pradesh and results shows that the beneficiaries used a portion of the scheme funds for non-agricultural uses. Therefore, the agriculture officials should inform them of the true objective of the scheme amount. The farmers should also be equipped with the new ideas, better quality seeds, and machinery to draw better returns from the investment. Beneficiaries can take advantage of the scheme amount and invest in agriculture for better returns because of the district's large Krishi mandi location, which is close to major cities like Agra and

Jhansi that would facilitate improved marketing facilities, a good amount of cultivable area, a river, and an irrigation canal when compared to other districts of Kanpur Dehat.

Lakshmi *et al*. (2023) examined the PM Kisan Samman Nidhi yojana's impact on Karnataka state's farmers. They found that even while the program is helping an increasing number of farmers, there are still obstacles that farmers must overcome in order to sign up and get financial assistance.

Sushmitha, (2020) conducted research on an assessment of funds utilization by farmers under Pradhan Mantri Kisan Samman Nidhi Yojana in Chikkaballapur district of Karnataka and the findings show that most PM-KISAN beneficiaries are middle-aged, belong to backward communities, and have primary-level education, with a majority relying on rainfed farming. After the scheme's implementation, the use of major agricultural inputs declined, likely due to external factors such as poor rainfall. Additionally, a large portion of the funds was spent on non-agricultural needs, mainly household consumption. This indicates that the scheme mainly supports immediate financial requirements rather than significantly boosting farm investment.

13. Research methodology

Research methodology focuses on describing and studying research processes and their actual, practical application. It encompasses the science and philosophy of research, exploring the reasons and methods behind using research tools and techniques. The approach may involve various methodologies like observation, questionnaires, and other tools for conducting research in the social sciences.

13.1 Source of data

The study will rely on both primary and secondary sources of data. Primary data will be gathered directly from respondents through structured personal interviews. Secondary data will be obtained from government reports, official documents, websites, and other published materials.

13.2 Description of the study area and sampling framework

The present study will be undertaken in the Saurashtra region of Gujarat during the year 2026–27. For the purpose of data collection, a multistage sampling technique will be employed to ensure a systematic, unbiased, and representative selection of respondents.

In the first stage, three districts will be selected randomly from the Saurashtra region. In the second stage, three talukas will be randomly chosen from each of the selected districts. In the third stage, three villages will be selected at random from each selected taluka. In the final stage, ten respondents will be randomly selected from each village. Accordingly, by following this structured sampling procedure, the total sample size for the study will be 270 respondents.

13.3 Statistical tools of analysis

To meet the specific objectives of the study, different analytical methods and approaches will be used.

13.3.1 To study the socio-economic profile of beneficiary farmers.

Tabular approach and descriptive statistics will be used to study the socio-economic profile of beneficiary farmers and to examine the utilization pattern of PM-KISAN funds by the beneficiaries. Tabular analysis is one of the simplest and most effective ways of presenting data. In this method, the collected data will be organized into tables with rows and columns, making it easier to understand patterns, comparisons, and relationships. It will help in summarizing large amounts of information in a clear and structured format. In descriptive statistics we will find the mean score and standard deviation from the collected data.

Mean: The mean is a statistical measure of central tendency that represents the average of a dataset. It is obtained by adding all the observations together and dividing the total by the number of observations.

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$$

Where,

$\sum_{i=1}^{n} X_i$= Sum of all observations

n= Total number of observations

Standard Deviation: Standard deviation is a measure of dispersion that indicates how much the observations in a dataset deviate from the mean. It shows the extent of variability or spreads in the data.

$$\sigma = \sqrt{\frac{\sum(X-\bar{X})^2}{N}}$$

Where,

σ = Standard deviation

X = Individual observation

$\bar{X}$= Mean of the dataset

N = Total number of observations

∑ = Summation

13.3.2 To assess the impact of PM-KISAN scheme on farmers income and living standard.

To address the issue of selection bias inherent in observational data, this study will employ Propensity Score Matching (PSM), a widely used quasi-experimental technique. PSM enables the construction of a comparable control group by matching treated and untreated units based on observable characteristics.

In the first step, a logistic regression model will be estimated, where the treatment status (beneficiary or non-beneficiary) is specified as the dependent variable, and relevant pre-treatment characteristics (such as age, education, farm size, income, etc.) are included as independent variables. This model generates a propensity score for each respondent, which represents the probability of receiving the treatment conditional on observed covariates.

Subsequently, treated units will be matched with control units having similar propensity scores using appropriate matching techniques (such as nearest neighbor, caliper, or

radius matching). Observations that do not find suitable matches will be excluded to improve the comparability between groups.

Following the matching process, the similarity of covariates between the treated and control groups will be evaluated to confirm that the procedure has effectively minimized selection bias. Finally, the impact of the intervention will be estimated by comparing outcomes between the matched groups, thereby approximating the conditions of a randomized experiment (Kane, 2020).

13.3.3 To analyze the change in agricultural investment pattern.

In order to assess whether the changes observed in the selected variables are statistically meaningful, the study will make use of the paired sample t-test. This method is suitable because the data is collected from the same respondents for two different time periods, namely before and after the implementation of the scheme. Since the observations are linked to the same individuals, they form natural pairs.

The paired t-test focuses on the difference between the two observations for each respondent rather than analyzing them separately. By calculating the average of these differences, the test determines whether the overall change is significant or simply due to random variation (Dashwant, 2007).

The test statistic is calculated as:

$$t = \frac{\{(\overline{X_1}) - (\overline{X_2})\}}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where,

$\overline{X_1}$ = Mean of X_1 dataset

$\overline{X_2}$ = Mean of X_2 dataset

$(\overline{X_1}) - (\overline{X_2})$ = Differences between the two means.

S_1^2 = Variance of X_1 dataset

S_2^2 = Variance of X_2 dataset

n_1 = Number of observations in X_1 dataset

n_2 = Number of observations in X_2 dataset

13.3.4 To examine the utilization pattern of PM-KISAN funds by the beneficiaries.

To analyze the utilization pattern of PM-KISAN funds among beneficiaries, the Multinomial Logit Model (MNL**)** will be employed. This model is appropriate as the dependent variable represents multiple unordered categories of fund utilization.

$$P(Y_i = j) = \frac{\exp(\beta_{j0} + \sum_{k=1}^{K} \beta_{jk} X_{ki})}{\sum_{m=1}^{J} \exp(\beta_{m0} + \sum_{k=1}^{K} \beta_{mk} X_{ki})}$$

In this model, (Y_i) denotes the utilization pattern of PM-KISAN funds by the i^{th} beneficiary, which is categorized into different mutually exclusive groups such as consumption expenditure, agricultural investment, savings, loan repayment, and others. The probability P (Y_i = j) represents the likelihood that a beneficiary allocates funds to the j^{th} category.

The independent variables (X_{ki}) include socio-economic and farm-specific characteristics of the respondents, such as age, education level, landholding size, annual income, farming experience, access to institutional credit, family size, and awareness about the scheme. The parameters β_{jk} measure the influence of these explanatory variables on the probability of choosing a particular utilization category.

For estimation, one category (e.g., consumption expenditure) will be treated as the reference or base category. The results will be interpreted in terms of log-odds, indicating how changes in explanatory variables affect the likelihood of selecting a specific utilization pattern relative to the base category.

13.3.5 To identify the constraints faced by the beneficiaries.

Friedman test will be used to identify the constraints faced by the beneficiaries. The Friedman test, introduced by Milton Friedman, is a non-parametric statistical technique used to identify differences among treatments over repeated observations. It serves as

an alternative to repeated measures ANOVA, especially when the data do not meet the assumptions of normality.

It works by ranking the data within each row (or block) and then comparing these ranks across columns. In this way, it serves as a special case of the Durbin test designed for complete block designs.

The Friedman test is commonly applied to evaluate individuals' mean scores across three or more different conditions. The constraints faced by the beneficiaries will be identified through primary data collection and broadly classified into categories such as economic, technical, institutional, and social constraints. The respondents will be asked to rank these constraints based on their severity. The collected data will be analyzed using the Friedman test, a non-parametric method, to examine the differences in rankings and to determine the relative importance of each constraint (Heena, 2024).

$$\chi^2_{r1}=\frac{12}{Nn(n+1)}\sum R_1^2-3N(n+1)$$

$$\text{at df} = n-1$$

Where,

n = number of broad constraints

N=number of respondents

$\sum R1^2$ = row ranks summed up in each column, squared and then added

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